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open market at $12.28 and sell later at $12.35 or higher. (They could not, of course, buy of the Government because the Government sells at 1% more than $12.28.) The result of such speculation would merely be a lull in minting gold toward the end of any quarter when a rise of price was expected and a gradual instead of a sudden rise in the market price. The opposite speculation for a fall might occur if the market price were at first equal to the redemption-price and a fall in Government prices were expected. Then there would be a lull in redemption at the end of the quarter and the fall of market prices would be gradual instead of sudden. These operations are entirely analogous to those connected with fluctuations in the foreign exchanges.

The limitations on the adjustment of the virtual dollar, etc., imposed for the purpose of preventing embarrassing speculation will, as we have seen, impair slightly the power of the adjustment to compensate for changes in the purchasing power of gold; yet a study of the actual movements of prices shows that it would easily be possible to avoid absolutely any possibility of embarrassing speculation and still permit, in all ordinary cases, the freedom of adjustment necessary to produce the desired regulation. If not, *i. e.*, if changes in prices are impending in the future so enormous that the system could not fully cope with them, there is all the greater need for adopting the system as a means of reducing these enormous fluctuations to a minimum!

APPENDIX II

ILLUSTRATIVE CALCULATIONS FOR 1896–1911

We may best picture how the plan would work by illustrating its various phases through numerical examples. Recent experience (since 1896) supplies a very severe test, while limiting the adjustment of the bullion dollar to 1% per quarter makes the test still more severe.

Taking the index numbers of the Bureau of Labor and changing them by simple proportion so that the price level of 1896 shall be 100%, let us consider what would have happened if on January 1, 1897, the system here described had been adopted. We assume that the weight of the coin dollar would have been left, as it is, at 25.8 grains. The index number for January,[1] 1897, was 1.5% below the par of 1896. Therefore, if the system here proposed had been in operation, it would have been impossible to have lowered the weight of the redemption-bullion; it was already at the minimum allowed, 25.8 grains. The new law would simply have been a dead letter so far as affecting the price level of January, 1897, goes, — that is, if gold were flowing *out* of circulation in the United States at the time; for it would still be withdrawn (by melting coin) as freely under the new law as under the old. But if (as was actually the case) gold was flowing *into* circulation, the new brassage charge of 1% at the mint would act as an impediment to coinage. We shall assume that the mintage of gold would have continued in spite of the brassage. The mint-price would therefore have ruled the market so that the price of gold would have fallen 1% and the price level of commodities would have tended to fall the same 1%.

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[1] The Bureau of Labor has published statistics giving the index number for each month beginning with 1900. Its previous index numbers are by years and not by months. The quarterly variations, 1897–99, have been calculated by means of the quarterly index numbers of Professor Commons for that period.

This depression of 1% below what were the actual prices would have been the only result until October, 1897, when there would have occurred the first opportunity to change the redemption-bullion; for at that date the index number was for the first time above par, viz. 104, and under the new system it would have been 1% less than this, or 103. This shows a deviation of 3% above par, which would have been the signal for raising the weight of the redemption-bullion. But it could not have been raised by the full 3%, but only by the maximum permitted, 1%. Consequently as soon as the necessary market reports could be gathered and the index number for October 1, 1897, calculated (say in a week or two) the redemption-bullion would have been raised in weight by 1% in order to press the rising price level back 1%. Let us assume that this effect would have been fully felt by the beginning of the next quarter, January 1, 1898. By that time, however, the downward effect of the heavier dollar would have been more than neutralized by those other forces which actually caused prices to rise by 1.1%. This historical rise occurred, of course, while the dollar remained unchanged. Evidently if the adjustable seigniorage system had been in operation, 1% of this rise would have been prevented. That is, the price level, instead of rising 1.1%, would have risen only .1%, and the index number for January 1, 1898, would therefore have been 103.1. We may put these calculations in the following form: The index number for October 1897 (103), *minus* the depression which the heavier dollar would have caused (1%), *plus* the rise actually experienced by January, 1898 (1.1%), equals the index number (103.1) which would have been found January, 1898. In short, $(103-1.0+1.1) = 103.1$.

The same kind of formula applies to the next quarter. The deviation above par of January, 1898 (3.1%) would have served as the signal for another increase of 1% in the weight of the redemption-bullion; but in the next quarter prices actually rose 3.2%, so that the price level in April, 1898, would have been $(103.1-1.0+3.2) = 105.3$. This shows a deviation above par of 5.3, and would entail a further increase of 1% in the redemption-bullion, which would have pulled down the price level 1% more than it actually did go down (7.1%). The index number for July, 1898, would then have been $(105.3-1.0-7.1) = 97.2$. This shows a deviation of 2.8 per cent *below* par which would therefore have been the signal for reducing the redemption-bullion, tho we are assuming it could not have been reduced by 2.8%, but only by 1%. This change would have tended to raise the price level 1% in the next quarter, during which it actually fell 2.2%. Thus there would have been a net fall of 1.2%. The index number for October, 1898, would then have been (97.2+1.0−2.2) = 96.0. The next five quarters show an unprecedented rise of prices which a mere adjustment of 1% each quarter could only have feebly checked.

In all cases so far considered the change in the redemption-bullion was the full maximum of 1%. This full 1% appears in most of the cases owing to the smallness of this margin and the fact that changes can occur only once a quarter. But in October, 1904, the index number was 99.2, which is only .8% below par. In this case, therefore, the redemption-bullion would have had to be reduced only .8%, which would have exactly offset the deviation. Consequently at the end of the next quarter the index number would have deviated from par only by the change occurring in the quarter, which was 2.0%; *i. e.*, (99.2 +.8+2.0) = 102.0.

Part of the series thus calculated is given in the text together with the index numbers of prices as they actually were in the same period, and the weight of the redemption-bullion as it would have been, had it been increased 1% October, 1897, and varied subsequently as required by the rules laid down.

We have assumed that gold continues to flow into the circulation, or that the mint price always rules the market. If, at any time, the market should be such as to require the redemption of gold coin, the price level would be 1% higher than otherwise. It might of course happen that the market would temporarily be intermediate between the two official prices and the price level vary by that amount from what it would otherwise be.

If more latitude be allowed in the changes in the redemption-bullion, say a brassage[1] of 3% (an allowed increase in weight of this amount each quarter and a decrease limited to 1%), we should be just as secure against embarrassing speculation and the results would be a much closer approximation to par. Beginning with October, 1897, when the increase in weight of the bullion dollar is first indicated, the results in part would be as follows: —

1896	....	100.0
October 1897	....	101.0
January 1898	(101.0−1.0+1.1) =	101.1
April "	(101.1−1.1+3.2) =	103.2
July "	(103.2−3.0−7.1) =	93.1
October "	(93.1+1.0−2.2) =	91.9
January 1899	(91.9+1.0+5.5) =	98.4

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[1] Or, better, the brassage might be 1%, but *increases* in weight of the bullion dollar of 1% be allowed monthly and *decreases* of 1% per cent allowed quarterly. The results of such an arrangement would be more laborious to calculate but would not be very different from the results actually calculated.

In this series the deviations from par are in most cases slight and due to the change in the price level going on during a single quarter before a correction can be applied. This is true in 36 cases out of 56. The entire series is shown in the diagram.

I have also gone to the trouble of calculating a third set of figures *by months*, beginning January, 1904 (and therefore including the most violent convulsions of the price level which have been experienced). In this third set of calculations the par is the price level of December, 1903, the brassage 1½%, the maximum increase allowable in weight of the redemption-bullion, 1½% per month, and the maximum decrease allowable, ½%. The results shown are much closer approximation to par even than in the second set of calculations. Only 7 times out of 96 does the index number vary by more than 1% above par and only 20 times by more than 1% below par. That is, in 69 cases out of 96 the index number kept within 1% of par. In only 7 cases was it necessary to increase the weight of the redemption-bullion by the full 1½% allowable and in only 23 cases was it necessary to reduce that weight by the full ½%. In other words, in 66 out of 96 cases the limitations on the adjustment were not called into play. As has been explained in the text, even the few cases where the correction applied was slightly hampered (by the limitations imposed to prevent speculation) would not all have existed (perhaps none of them) if the system were in actual operation. The reason is because there would not then have been the price-convulsions which we now suffer, and which are due to the alternation of accumulated upward booms and downward reactions therefrom, which feed on themselves, so to speak.

I will not encumber these pages by giving the details of this laborious calculation, but confine myself to a few illustrative cases.

Assuming December, 1903, as the base for which the price level was taken, or 100%, the level for January, 1904, was actually 101.3 and would have been the same under the system proposed if we could assume that the redemption-price were the ruling price of gold. But we assume, as before, that the mint-price was the ruling price and as this has been lowered 1½% (by the establishment of the brassage charge, which we will suppose was imposed in December, 1903) the level of prices would have been depressed by 1½% below what it would otherwise have been (viz. 101.3) so that it would have been 99.8. This deviates from par by .2% which, being negative, would ordinarily be the signal for a fall in the redemption-bullion; but not in this case, because the redemption-bullion is already at the lowest point permissible (25.8 grains). Consequently the system would not operate and the price level in February, 1904 would have risen exactly as much as it did rise, namely 1.1% which would have raised it from 99.8 to 100.9. The *positive* deviation .9% now serves as signal for an increase in the virtual dollar by that amount (thus raising it from 25.8 grains to 26.03

grains) and tends to depress the price level by the same percentage. Assuming that this effect would have been fully felt before the next adjustment, it would have been blended with the actual rise of prices in that time which was .2%, making for March, 1904, the index number (100.9−.9+.2) = 100.2. We, therefore, next increase the weight of the virtual dollar by .2% for April, 1904, which becomes 26.08 grains and the index number becomes (100.20−.20−.52) = 99.48. This shows a deviation *below* par of .52%, but under the limitations imposed we can only take off .50 from the weight of the virtual dollar. This brings it to 25.95 grains and the index number for May becomes (99.48 +.50−.70) = 99.28. The deviation here indicated of .72% below par is the signal for another full reduction in the virtual dollar of .50% so that it becomes 25.82 grains and the next index number (99.28+.50−.27) =99.51. The deviation here indicated of .49% below par would ordinarily produce a reduction in the weight of the virtual dollar of that amount. But as its weight is already down to 25.82 grains, and can never sink below 25.80, it can only be reduced to this extent, or .08%. Consequently in June the virtual dollar is again 25.8 grains and the index number (99.51+.08−.80) = 98.79. After this date the virtual dollar remains 25.8 grains for several months and the price level drifts unguided. During this period, the index number remains below par, reaching its lowest point (98.61) in October, 1904. It rises above par again in December, 1904, becoming 100.11, thus signalizing an addition of .11% to the virtual dollar, which accordingly in that month is raised from 25.80 to 25.83 grains. Thereafter it never again sinks to 25.8 throughout the period to the present.

Nothing more requiring explanation occurs until December, 1906.

In November, 1906, the index number is 101.80 under the system (as contrasted with 112.5 without it). For each of the six preceding months the calculations show a steady tho small increase in the weight of the virtual dollar. The deviation above par of 1.80% for November, 1906, requires a further increase (viz. 1.50%, the maximum allowable). This increases the redemption-bullion from 28.06 grains to 28.48 grains. In view of this great increase following after a previous steady increase, this seems a good place at which to suppose the added seigniorage to shut off minting entirely. The mint-price would then cease to rule the market and (we shall suppose) a market price is fixed midway between the mint-price and the redemption-price. The result is that tho the correction of 1.50% in the virtual dollar tends to depress the price level by 1.50%, it is restrained from so doing by .75%. Since prices actually rose 1.50% in the next month, the next index number (for December, 1906) becomes (101.80−1.50+1.50+.75) =102.55. The deviation above par of 2.55% is the signal for a further increase in the redemption-bullion, which accordingly increases from 28.48 grains to 28.91 grains. But we shall now suppose that this further increase in the virtual dollar brings the market price of bullion up to the redemption-price. In other words, we are assuming that the mint-price which formerly ruled gave way in two months to the redemption-price, the market price in the midway period being midway between the two Government prices. The consequence is that the shift in the redemption-bullion is only half effective in each of these two cases, because the bullion to which the actual dollar is equivalent instead of being, as formerly, the mint-bullion, falls, first half way, then fully to the redemption-bullion. The next index number (for January, 1907) is (102.55 −1.50+.20+.75) = 102.00. We now suppose the redemption-price to rule until May, 1907. (In the meantime the index number gets adjusted to the new ruling redemption price and returns closer to par, being successively 101.40, 100.20, and 97.77.) In May, 1907, we shall suppose that the redemption-price in turn ceases to rule and the market price is found first midway between the two government prices and then at the mint-price again. Thus the index number for May, 1907, becomes (99.77+.23+.40−.75) = 99.65, and for June, 1907, it becomes (99.65+.35+.40−.75) = 95.65.

These divergencies of the market price from the mint-price are supposed merely for the purpose of illustrating how the system would work when they occur. It is clear that the system would work less effectively while the market price swings from one limit to the other. Yet if the market price keeps for several months in coincidence with *either* the mint-price *or* the redemption-price, the system works equally well. Only during the transition is the result to aggravate any existing deviation from par and then only by the extent to which the market price has moved away from its accustomed limit, whether this was the mint-price or the redemption-price. In general, as has been previously remarked, the mint-price will rule because, with the constant growth of trade, there is usually need of more gold to be minted to keep up the level of prices. Hence we need not expect the "wabbling," so to speak, of the market price away from the mint-price and back again to occur very often. Even when it does occur the result is not at all serious, as the following comparisons for the above named period show: —

Date	Index Number	
	Mint-price ruling	Market price " wabbling " as specified
November 1906......	101.80	101.80
December "	101.80	102.55
January 1907	100.50	102.00
February "	100.90	101.40
March "	100.30	100.20
April "	99.77	99.77
May "	100.40	99.65
June "	100.40	99.65
July "	100.20	100.20

The figures show very little aggravation of the deviations from par. That is, the second column varies from par only slightly more than the first. The figures for the index numbers and the weight of the virtual dollar in this third set of calculations have been summarized in the text.

We have assumed throughout that only the United States adopted the plan so that the effect on the price level of changing the weight of the bullion dollar would be approximately equal to its change in weight. But the stabilizing effect would be nearly as great even if the whole world adopted the plan and this full assumed effect were not felt (as explained in Appendix III). As stated in Appendix III, it might, however, be advisable to shift the weight by a percentage one-half larger than the percentage by which the price level deviates from par, subject, of course, to the usual restrictions.

It is clear that the proposed system, if not perfect, certainly tends strongly to bring the index number back toward par or to restrain its movements from par, and that if properly planned as to frequency of application and freedom of movement, it could always maintain substantial constancy of the purchasing power of the dollar or, in other words, of the level of prices.

APPENDIX III

THE EFFECT ON THE VALUE OF GOLD BULLION OF CHANGES IN THE WEIGHT OF THE VIRTUAL DOLLAR

For simplicity we have hitherto assumed that an increase of 1% in the weight of the dollar would, ultimately at least, increase its purchasing power 1%. But this is not quite true; for the effort to pry up the dollar on a fulcrum of gold bullion reacts on and depresses the bullion itself. Using gold bullion as a fulcrum adds a further depreciation to that which it had already. We cannot even pry up a stone without infinitesimally depressing the earth. If the stone were big enough, the earth would be moved as far as the stone. A better simile is found by supposing two canal boats or rafts, "money" and "bullion," drifting freely in a canal, one ahead of the other, and free to move only longitudinally, *i. e.*, along the canal. The problem is to keep the money raft opposite a fixed point on the shore (commodities) by adjusting a pole connecting it rigidly with the bullion raft. If, by observing the shore, it is found that the rafts have, while thus linked together, drifted a foot, the pole between the rafts must then be lengthened or shortened a foot in the hope of bringing the money raft back where it belongs. If the money raft is small and the bullion raft large, an adjustment of a foot in the pole will move the small money raft almost a full foot. The next periodical reading of the index number showing the position of the mark on the shore and the consequent adjustment of the rod will help further. But the pull or push of the rod will always move the bullion raft *somewhat,* altho a prompter and more perfect adjustment of the money raft might be secured if the rod were lengthened or shortened by more than the foot which the reading indicated.

To apply these ideas let us suppose that the United States, and the United States only, had first adopted the proposed scheme in 1896 and so had gradually raised the weight of the bullion dollar until the present time. As a consequence, the purchasing power of the American dollar would be in 1912 about the same as it was in 1896. This means that it would be about 50% higher than it actually is at present. The question here raised is, would the *weight* of the bullion dollar also have grown by just 50%? The answer is that it would not have grown by just 50% but by a larger amount, unless we could assume (and we cannot) that each grain of gold today would have possessed exactly the same purchasing power under the proposed system as it actually does possess today without any such influence having intervened. We may see this by following in imagination the operation of the system in the years 1896–1911. As prices rose and the mint-price was reduced, evidently the first effect of the lower mint-price would have been to discourage minting gold in America. Instead, American holders of bullion would have shipped it to the London mint (and other foreign mints not employing the adjustable seigniorage system) where the mint-price would have been as high as ever, and sell exchange against it. In this way they would have secured more American money than by direct selling to American mints.

But the very operation by which they attempted to profit would soon correct itself. It would lower the rate of exchange on London until there would be no longer any profit in sending gold from the United States to England and selling exchange against it. When this happened it would be as profitable to sell gold to American mints as to ship it abroad, and a new par of exchange would be established corresponding to the new weight of the American dollar.

But in the process described much of the gold which has actually been minted in the United States since 1896 would, if the adjustable seigniorage had been employed in the United States, have been diverted into foreign countries or into the arts. So vast is the world, however, that this dumping a few millions of gold on Europe would scarcely affect its value. If we could assume that it would have had practically *no* effect on its value, then the price level outside of the United States would have been today practically just what it is. That is, the purchasing power of each grain of gold would have been just what it actually has been and (since, as we have seen, the purchasing power of the American dollar would have had to be 50% more than it is), it follows that our gold dollar would have had to be 50% heavier than it is.

If, however, the diversion of gold from the American currency to foreign currencies and the arts should cause a depreciation of, say, 3%

in the value of gold bullion, it is evident that the weight of the American gold dollar, instead of being only 50% greater, would have had to be 3% more than this, or 54½% greater, in order to have had 50% more purchasing power; and the system of compensating the dollar according to index numbers would have afforded this needed correction.

Now if not one country only but all countries should have adopted the adjustable seigniorage plan, the reaction or repercussion on the value of bullion would have been much greater. Yet even if, because of the repercussion, each increase in weight of the bullion dollar of 1% should add only ½% to its purchasing power, the steadying effect on the purchasing power of the dollar would be surprisingly effective. Suppose, for example, that the price level *without the operation of the system* tends to rise by ½ of 1% each quarter or 2% per annum regularly. Calling the original price level 100%, the index number at the end of the first quarter would be 100+.5, or 100.5. The bullion dollar would now be increased by .5% which, according to our present supposition, would tend to lower the price level only half as much, *i. e.*, ¼ of 1%. As during the second quarter the price level tends to go up ½%, the real rise will be 100.5−.25+.5, or 100.75. Accordingly the next quarter would see an increase in the bullion dollar of .75% and the price level will be 100.75−½ (.75) +.5, or 100.88. The next increase in the bullion dollar will be .88% and the index number will be 100.88−½ (.88)+.5, or 100.94, and the next 100.94−½ (.94)+.5, or 100.97, and so on. It is evident that the index number would never exceed 101, but would always be above par so long as the regular upward tendency of ½% per quarter continues. The bullion dollar would increase faster and faster, each year, yet never quite as fast as 1% at any one shift.

Again, if there were a regular upward movement of 1% per quarter instead of ½%, the index number would be at the end of the first quarter, 101. Consequently 1% would be added to the weight of the bullion dollar which would tend to reduce the price level by half that amount (.5). At the next quarter it would be 101−.5+1, or 101.5. The next shift in the weight of the bullion dollar could not be 1½% but only 1%, the greatest allowable. The effect of this being ½%, the index number becomes 101.5−.5+1, or 102. Evidently the result in this case would be a net addition of .5 to the index number every quarter. That is, prices would rise steadily, but only half as fast as without the mitigating effect of the system. Thus we see that the system would always serve to mitigate changes in the purchasing power of the dollar even if, on account of the repercussion on the purchasing price of each grain of gold, it should not be quite adequate. Any inadequacy, however, might itself be compensated for by magnifying the correction to be applied. To revert to our simile, we could, in order to correct the position of the money raft, lengthen or shorten the pole by *more* than one foot for each foot of deviation from the required position, in order to allow for the effect on the bullion raft of this shift in the pole connecting the two. That is, it is not necessary that the shift in the weight of the redemption-bullion should be exactly equal to the deviation from par of the index number. It might be greater. Thus the rule might be to raise or lower the weight of the redemption-bullion by ½% for each deviation of ¼% above or below par of the index number. There might be some advantage in thus making the shift somewhat greater than the deviation, provided of course it were not made too great. Evidently if the shift were *more than double* the deviation it might *over* correct the deviation so much as to produce a deviation greater than the original in the opposite direction. But if the ratio of the shift to deviation were fixed somewhere between 1 and 2, say at 1½, the result would probably be a prompter and completer adjustment than if the ratio were 1, *i. e.*, if the shift were equal to the deviation.